Towards a Wastemangement System for Solar-Home-Systems in Bangladesh

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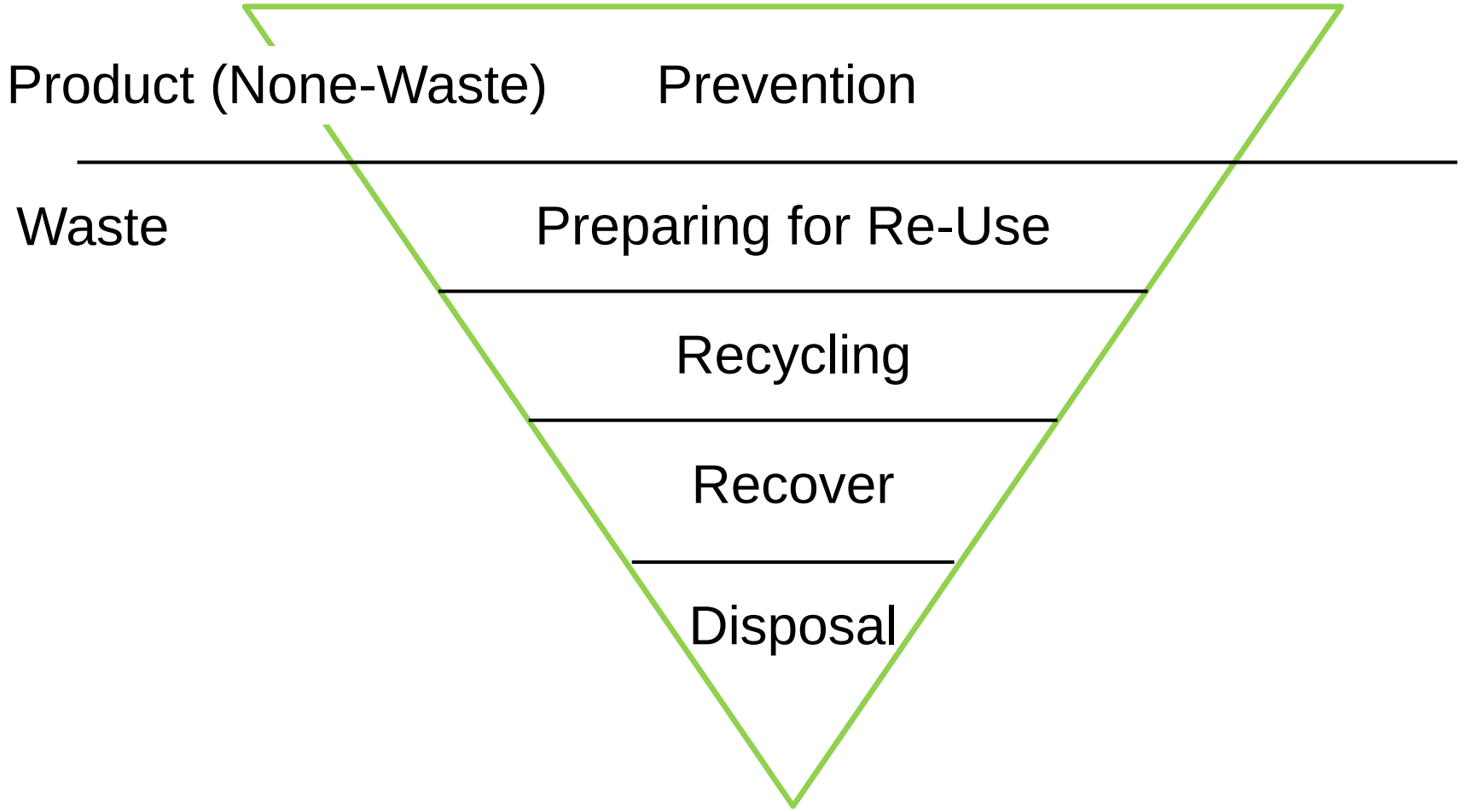
Waste Hierarchy according to the European Directive on Waste



SHS in Bangladesh – Installation Rate

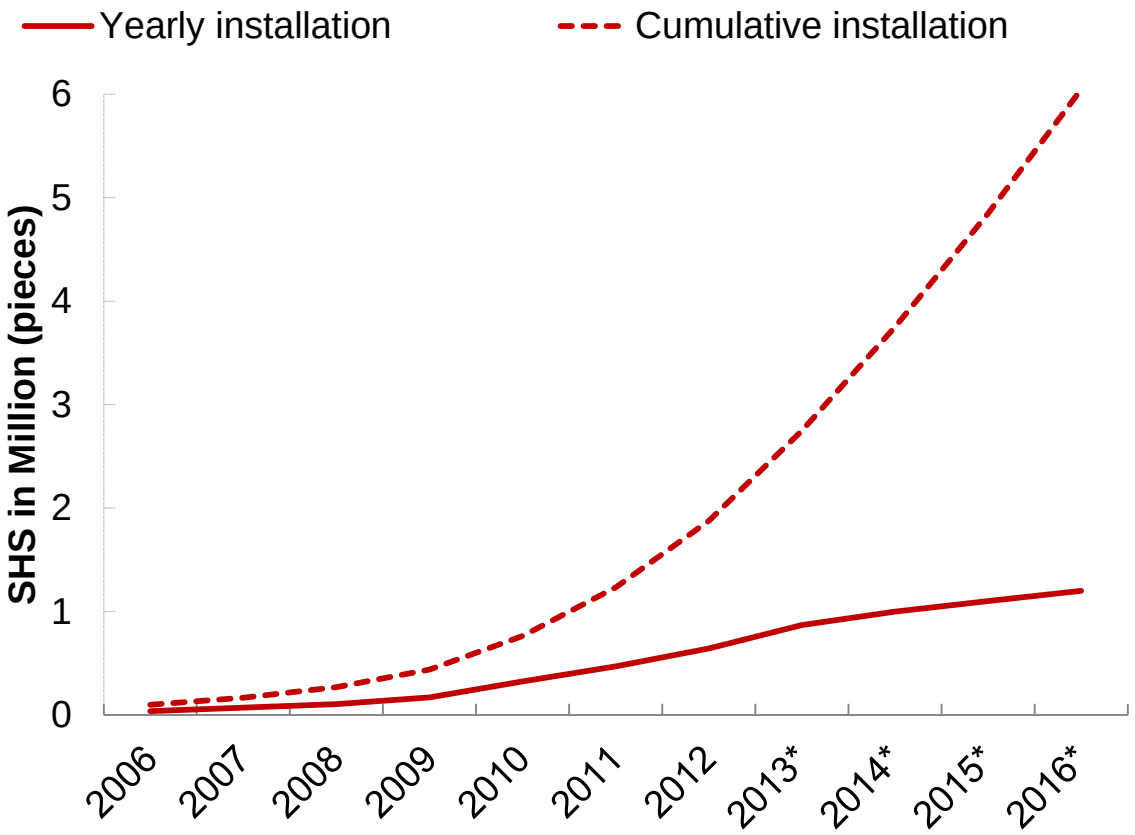


Figure 1: SHS in Bangladesh (WB 2013a; IDCOL 2014; own calculations based on IDCOL 2014)

Guiding questions for designing a Waste Management System

Waste Management System Design:

- When will the different parts of the SHS enter the Waste Management System?
- How many items have to be collected?
- What is the total mass of the items to be collected?
- Is there data available for modelling the estimated waste flows?
- What are the expected environmental impacts?

Expected Environmental Impacts during End of Life of SHS (IDCOL 2013)

Environmental and Social Management Framework

1.) Improper disposal of used lead acid batteries (ULAB)

2.) Improper disposal of solar panels

Market Supply Model (Wang et al. 2013) for estimating future waste flows

$$W(n) = \sum_{t=t_0}^{n} POM(t) \cdot L^{(p)}(t,n) \qquad (1)$$

- W(n) is the estimated waste generation in year n, representing the number of LABs entering the waste management system.
- POM(t) equals the historic sales, or the historic installation numbers of SHS.
- $L^{(p)}(t,n)$ is the annual disposal rate of LAB

$$M(n) = W(n) \cdot m(Ah) \cdot P \qquad (2)$$

- M(n) is the expected mass of lead
- m(Ah) is the mass of the battery depending on the capacity
- P is the average percentage of lead in LAB

$$Ah = W_p \cdot F \qquad (3)$$

- Ah is the average capacity of a lead-acid battery used in SHS
- W_p is the average nominal power of the SHS
- F is a factor between nominal power of the solar panel and the battery capacity

Assumptions and limitations of the modelling

Assumptions of the modelling:

- Nominal power of SHS 40W_p
- Battery capacity of 60Ah (Factor 1.5)
- Battery weight of around 15kg
- 50 Percent of the weight of a battery is lead
- Linear distribution of battery failure

Limitations of the modelling:

- Modelling only till 2016 (market in growth)
- No system dynamics (linear modelling)
- Scarcity and quality of data

Estimated Disposal of LAB (pieces)

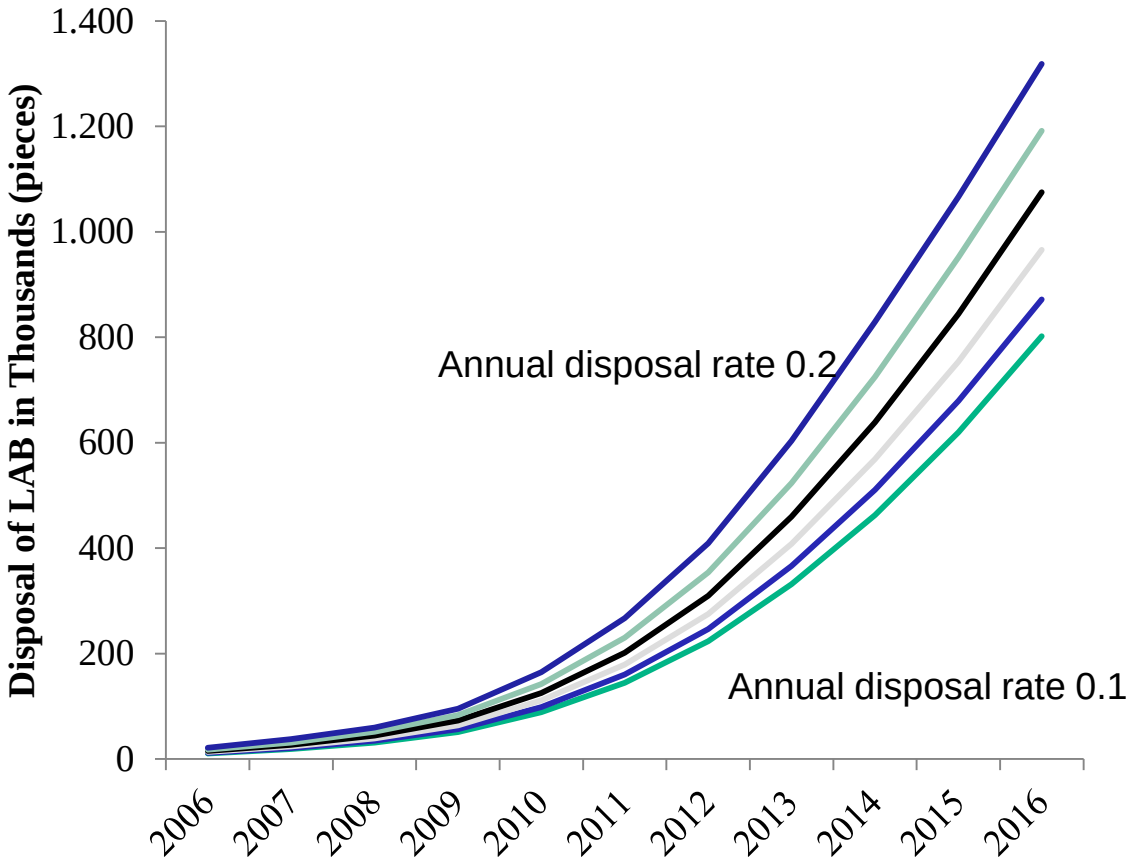


Figure 2: Estimated disposal of LAB

Estimated Mass of Lead of ULABs.

	2006	2008	2010	2012	2014	2016
mass of lead in t (min.)	81	233	666	1.676	3.469	6.015
mass of lead in t (max.)	162	448	1.235	3.068	6.221	9.888

Table 1: Estimation of the total amount of lead depending on the annual disposal rate

- Expected amount of lead has almost grown by twenty times between 2006 and 2012
- In 2010 the Department of Energy of Bangladesh announced in their national 3R-Strategy, that SHS will have a huge impact on ULAB-Recycling (DOE 2010)
- In 2006 around 3.000 metric tons of Lead were recycled in the formal sector of Bangladesh (Waste Concern 2006)

Discussion of the results

- The SHS-Program already has significant influence on LAB recycling and industry in Bangladesh
- Accessibility and quality of data is a limiting factor in the model and should be improved
- Lifetime of LAB is the key factor for designing a waste management system for Solar-Home-System
- Collecting System is the key factor for high recovery rates of lead and close the material cycles

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